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March 8, 1965

NASA BIOG

Statement of
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Administrator

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the

Committee on Aeronautical and Space Sciences
United States Senate

Mr. Chairman and Members of the Committee:

We appreciate this opportunity to present the status, management, and prospects of the aeronautical and space program.

The benefits of this country's broadly based approach to aeronautical and space activities, which has been supported and approved by your Committee under policies established by the National Aeronautics and Space Act, were clearly apparent during the past year. The broad base of our activities enabled us to conduct important aeronautical research, unmanned scientific space missions and communications and weather satellite experiments; it permitted the achievement of significant advances in the technology of space systems during a period when, for the first year since 1961, no manned missions were flown; this broad base of our space activities has permitted this country to achieve significant firsts in space and has demonstrated this country's strong position in all fields of aeronautics and space exploration. This development of a broad base is the course we chose when, in 1961, we realized that we were not proceeding fast enought to overtake the Soviet progress in space. This country determined then that it must have a national capability to perform any necessary mission in space to protect our interests and to reap the harvest of scientific knowledge and practical use from this new environment.

In unmanned space missions we moved ahead during the past year on many fronts.

-- Ranger VII took 4,316 closeup TV pictures of the moon in the area of the Sea of Clouds which has, as a result of these observations, been named Mare Cognitum, or the Sea that has Become Known. These pictures revealed for the first time objects of a 3 foot size, a thousand times smaller than anything that had been photographed previously through the largest ground telescopes. Of great importance to the space program, these pictures indicate that the surface features of the moon will not hinder manned landing. On February 20, 1965, Ranger VIII provided over 7,000 pictures of the area of the Sea of Tranquility and those pictures are now under active study.

-- Mariner IV has now been on its way to Mars since November 28, 1964. If all continues to go well it will reach and fly by Mars on July 14 of this year. Cameras on board the spacecraft will take 21 pictures of the planet from as close as 5,400 miles. These photographs will be 50 to 100 times better than any taken from the Earth.

-- The first Orbiting Geophysical Observatory, OGO I, was placed in an eccentric Earth orbit last September. It is meeting many of its objectives of mapping the magnetic and radiation fields of the Earth, although operating in a spin stabilized mode instead of the intended Earth oriented mode. The OGO carries twenty experiments, and it is a major step forward in taking simultaneous measurements of space phenomena for multiple purposes.

-- The second Orbiting Solar Observatory was put into service on February 3, 1965, and continues the observations of solar phenomena that were begun by the highly successful OSO I.

-- The Relay II active communications satellite and the Echo II passive satellite continued the research and development begun with Relay I and Echo I. It is interesting to note that although some degradation had taken place Relay I is still operating after more than 2 years in space.

-- Syncom III was placed in a synchronous equatorial orbit in August 1964. It was positioned so accurately that it drifts westward only one mile per day and north and south of the equator less than six miles a day--all this at an altitude of about 22,500 miles above the Earth's surface. In addition to demonstrating an extremely accurate launch and positioning capability, Syncom III also demonstrated the usefulness of communication satellites in synchronous orbit by transmitting real time television of the Olympic Games from Japan to the United States; and by providing a useful resource to the Department of Defense.

-- Nimbus I, a second generation Earth oriented meteorological satellite, was also placed in orbit in August of 1964. In addition to the standard television transmission system, Nimbus I carried an automatic picture transmission (APT) system which permits small, inexpensive ground stations to read out their local cloud cover directly from the satellite as it passes overhead, and a high resolution infrared system which provided for the first time in pictorial format and on a real time basis cloud cover information from the dark side of the Earth.

-- The ninth Tiros, the first cartwheel version which continuously views the earth was launched January 22, 1965.

Although the orbit achieved was higher than that intended, highly useful pictures are being returned.

-- All told, 9 scientific satellites and 5 communications and weather satellites have been successfully launched during the past year, bringing the total since 1958 to 28 scientific satellites and 20 application satellites.

These flight records of our unmanned space sciences and applications program tell only part of the story of this year of progress. There has been a great increase in the knowledge of the space environment that has resulted from the measurements made in the space science flights and from the demonstrations of the practical utilization of space technology through the communications and weather satellites.

We might note a few of these advances. The flux of solar x-rays was found by OSO I to correlate well with the passage of active regions across the surface of the sun. Sounding rockets located at least six celestial x-ray sources and made many accurate measurements of the constituents of the atmosphere. Explorer XVIII continued the mapping of the magnetosphere, and discovered the turbulent wake of the Moon in the solar wind. As previously mentioned, Ranger VII and VIII provided over 11,000 pictures of the lunar surface. Nimbus I provided night time cloud cover pictures for weather prediction and from which some determination of cloud heights could be made. In addition, the infrared measurements made by Nimbus permit for the first time the determination of the surface temperature over large areas of the earth--data important to determining the heat budget of the Earth.

During the past year the progress that was made in increasing our national capability in space flight and in aeronautics through our research and technology activities has, I believe, been more rapid than in any previous period in our space program history.

-- The X-15 rocket plane entered its sixth year of powered flight research operation with a total of more than 4 hours of flight above a mach number of 3; more than 2½ hours above mach 4, a speed impossible for any other aircraft; more than 40 minutes above mach 5; and almost 12 seconds above mach 6.

-- Recent successful flights of the XV-5A vertical takeoff and landing aircraft are the culmination of an eight-year program originated by the National Advisory Committee for Aeronautics. The first hovering flight of that aircraft was accomplished on March 31, 1964, and since that time complete transition from hovering to forward flight has been achieved several times.

-- A small ion engine for advanced electric propulsion was tested for the first time in space. It resolved the only fundamental uncertainty concerning the potential use of such engines in the space environment by proving that a buildup of electric charge could be avoided in space.

-- Very important successes and advances were achieved in nuclear rocket propulsion with the testing of the KIWI and NERVA reactors in ground tests. A specific impulse, equivalent to altitude conditions, of approximately 750 seconds was achieved in those tests compared with the 450 seconds that is the best possible with the chemical rocket systems that are now under development.

-- In Project FIRE the reentry heating on a body traveling 25,000 miles per hour or about 37,000 feet per second was experimentally determined and demonstrated reasonable agreement with the analytical results. This experiment supplemented by the materials reentry experiment, R 4, conducted on a Scout vehicle indicated that the heating associated with entry into the Earth's atmosphere at speeds up to and even beyond that of the Apollo command module on its return from lunar flights and the behavior of the heat shield materials required to cope with this heating can now be predicted with assurance for engineering design purposes.

Here again it should be cautioned that the flight successes do not alone demonstrate the accomplishments being made. The accomplishments in ground laboratories to improve the capabilities of materials for the various uses to which they will be put in aeronautics and space; to provide power systems that will be able to operate over the entire range of space missions and space environmental conditions; in the biotechnology work to provide improved space suits and methods of sustaining man in space for long periods of time; in the research support of the supersonic transport development and of the F-111 aircraft; in the electronics research activities; and in the basic research work in many categories--all contribute in a major way to increasing this country's capabilities in aeronautics and space and to providing the options that must be available to this country if it is to be able to protect its interests in space.

Further development of our launch capability was demonstrated by the flights of Saturn I and Centaur.

-- The Saturn I launch vehicle achieved operational status after orbiting a record weight of 39,200 pounds and successfully testing its high energy, liquid hydrogen second stage three times. That vehicle was launched successfully for the eighth consecutive time two weeks ago when it was used to place the large Pegasus meteoroid penetration experiment into orbit.

-- The liquid hydrogen upper stage Centaur rocket that will be used with an Atlas first stage booster for the Surveyor lunar mission and that will later be used in combination with the Saturn IB booster for the Voyager mission to Mars was successfully flight tested on Atlas twice. However, in the latest test attempt, conducted last week, the Atlas vehicle failed and serious damage to the launch pad resulted. Prior to this failure, 28 consecutive Atlas flights had been successful.

During 1964 important progress was made in building up the manned space flight competence of this country. Ground test models of the various booster stages and spacecraft components are being delivered. Through extensive ground testing in facilities that simulate as closely as possible the launch and space flight environment. We will do the testing necessary to assure that this equipment can meet the requirements of manned flight. High priority has been given to building the complex environmental equipment and facilities needed to permit such testing.

About 35 test facilities have been built or are under construction to support the development of the Apollo flight hardware. These include static test stands for engines and rocket stages at Marshall and the Mississippi Test Facility, Apollo and LEM spacecraft test facilities at White Sands, environmental vacuum chambers for complete Apollo spacecraft tests, and a centrifuge capable of handling the Apollo command module at the Manned Spacecraft Center. Many other test facilities are located at contractor sites and other NASA Centers.

Tests have already been initiated on many of the subsystems that will be required in the Apollo mission. The electrical subsystems, for example, are well into test operations. The first tests have been run on a boilerplate version of the second stage of the Saturn V vehicle. The F-1 engine and the J-2 engine have now passed their preliminary flight rating tests and the first stage of the Saturn V vehicle is now being installed in the test facility of the Marshall Space Flight Center that was built for that purpose.

While these test articles were being built and the test equipment and facilities constructed, the manufacturing lines for flight equipment have been forming. Techniques have been provided to assure the rapid feedback from our test operations so that the equipment delivered for flight use will work properly, will perform the missions as they have been planned, and will be as reliable as they can possibly be made in advance of flight operation.

This requirement for rapid feedback of test data, combined with the requirement to have all parts of the system match up and ultimately meet at the same time at the launch pad is a real test of the management system that we have established for this massive and complex undertaking. There are, in each complete Apollo system, 14 major engines, many small thrust units, three rocket stages, 2 major spacecraft, enormous amounts of electronic gear and control devices, guidance and communications systems, all of which must operate properly when assembled together and all of which must be available at the same time so that the entire system may be tested on the same flight.

The important concepts that are necessary for the success of such a complex undertaking have been put into practice, including detailed configuration control, continuous updating of the testing program, and required modifications of flight equipment as the testing program reveals the improvements needed and component manufacturers introduced improvements into systems and subsystems.

As part of this overall management system the integrated checkout system is now moving into manufacture so that the equipment will be available to store and provide access to all of the knowledge necessary to follow the Apollo testing, production, and launch operations and to permit the critical decisions that may have to be made at any stage of the operation.

In conducting this program as a budget level of 5¼ billion dollars as it approaches its maximum instead of an optimum maximum considerably higher, we have thereby necessarily stretched out certain elements of the program. As a result all 15 Saturn V-Apollo flights that are included in our plan will not be accomplished within this decade. In our original plan fifteen flights were scheduled within the decade to provide assurance that we could achieve the goal of manned lunar landing by 1970. We believe, however, that the effective close control system we have established, and the early indications of better than predicted results from our testing program and with the flight successes achieved with the Saturn I vehicle, we have good reasons to expect that we still have some possibility of carrying out a manned lunar landing within this decade.

Our overall major milestones are being met. If we find we can launch toward the moon on earlier flights than we thought a year ago would be possible, one earlier than the 15th may make it. Obviously, such an acceleration is no more than the best estimate we can make at this time. What we can say is only that the equipment for the utilization of men for flights of all kinds out to the distance of the moon are now rapidly proceeding into tests that will determine any imperfections. The results of these tests and the knowledge that we are steadily accumulating about the space environment and the capabilities of our equipment do give us more confiden that we had a year ago that we are on the right track and proceeding on a reasonable course and schedule for the development of the machines, facilities, and information needed to accomplish our goals.

The progress during this period in the space program has been made possible by the cooperative efforts of many organizations and people. Ninety-four per cent of our work during Fiscal Year 1964 was conducted by American industry and involved a total of about 380,000 people in industry, universities, research institutes, and government installations. Almost 250,000 separate procurement transactions were initiated during this time. Great progress has been made by American industry and we have all worked together toward increased efficiency, better cost control, and better utilization of the total resources of our contractor organizations.

In addition, the management of many of these contracts by the Department of Defense and the handling of the construction of many of our facilities by the Corps of Engineers have made major contributions to the progress of the past year. Further, the assignment to NASA of outstanding project leaders and other specialists from the military services and the recruitment of seasoned executives from industry for important management responsibilities has produced a most valuable partnership effort.

On a broader scale, the past year saw the continued strengthening of the coordination and the mutual support between NASA and the DOD in space and aeronautics. The Aeronautics and Astronautics Coordinating Board has continued to be an effective medium for formal coordination. During 1964 NASA and the DOD developed procedures for the coordination of the space science programs; a national program in satellite geodesy was established by the DOD, NASA and the Department of Commerce; a standardized basis for reporting space and aeronautical sciences research and technology information has been adopted; a joint NASA-DOD study was conducted to determine the launch vehicles needed to meet projected requirements during the next decade; a joint study was conducted of the current and planned lifting reentry vehicle research and development programs; the needs of NASA, the Air Force, and the Federal Aviation Agency were incorporated into an expanded flight research program utilizing the XB-70 aircraft to confirm theoretical and wind tunnel data on supersonic flight vehicles.

The efforts of the AACB have been re-inforced and supplemented by the work of numerous joint ad hoc groups and by day-to-day exchanges between the two agencies involving personnel at all levels of responsibility.

The space activities of both agencies can indeed be viewed as parts of one national program. The coordination between the two agencies has clearly indicated that we are integrating the two parts of our programs that they complement rather than duplicate each other.

A third member of the national space team -- in addition to government and industry -- is the university with its scholars and researchers, where much of our most advanced work is going forward.

The government, industry, and university partnership can be illustrated by the second orbiting Solar Observatory, OSO II. This spacecraft was launched by a Thor booster derived from military programs, combined with the Delta rocket developed by NASA. The Thor booster is built by Douglas in California. The spacecraft was built by the Ball Brothers Research Corporation of Colorado. The experiments were designed and developed by NASA's Ames Laboratory; the Goddard Space Flight Center; the Naval Research Laboratory; the Harvard College Observatory; and the Universities of New Mexico and Minnesota. In addition to demonstrating our government-industry-university partnership, this project also illustrates the management complexity involved in these undertakings and the success of the system we have established.

About 185 universities are working on NASA-sponsored research. NASA's sustaining university program is developing very well. And 142 universities in all 50 states and the District of Columbia are now participating in the predoctoral training program. Nearly 2,000 graduate students are now engaged in research and advanced training under this program, and the number will increase to more than 3,000 this fall.

In earlier years, this Committee and other members of the Senate have been concerned about the utilization of scientists and engineers in NASA's programs. During the past 3 years, the national requirements classification of scientists and engineers increased by an estimated 232,000; NASA and its contractors required 63,000 additional scientists and engineers during this same period. This means that, although all 63,000 did not come from the additions to the requirements pool, NASA absorbed about 25 per cent of the increase in this pool. This brought our utilization of scientists and engineers to 5.4 per cent of current national requirements. Of considerable interest, however, is the fact that during the next 3 years NASA will absorb only 3 per cent of the increase in overall requirements and its utilization will drop to 4.8 per cent, and by 1970 will be down to 4.4 per cent. That important inner group, the research and development scientists and engineers, comprises about 40 per cent of the national requirements total.

NASA and its contractors absorbed a number equal to 40 per cent of the increase in R&D scientists and engineers over the past 3 years, but will absorb only 5 per cent of the requirements increase over the next 3 years. Thus, the utilization by NASA of research and development scientists and engineers will drop from the present level of a little over 10 per cent of this national resource to 9 per cent 3 years from now. This comes, of course, during a period when other work for a certain number of these scientists and engineers has not been available. In fact, there is some unemployment although not among the most capable and creative groups.

The accomplishments that I have briefly summarized for the past year and the benefits that are being felt do not fully describe this Nation's efforts in space. The President stated this very clearly when he visited NASA two weeks ago. He said, "Our purpose remains firmly fixed on the fixed objective of peace. The frontier of space is a frontier that we believe all mankind can and should explore together for peaceful purposes, and I have enunciated that doctrine in all the forums in which I have been allowed to trespass. This has been and is going to continue to be the policy and the purpose of the United States Government --- more than three-fifths of the nations of the Earth have voluntarily joined us in these endeavors. I hold the hope that some day all mankind may be united in this common exploration of the dominion of the stars."

Dr. Dryden will give this Committee a more complete statement of our international programs and our efforts to work cooperatively with the countries of the world to fulfill the objectives enunciated by the President. Dr. Seamans and the program directors will more fully discuss the operations of NASA and the plans of the agency.

Earlier, I spoke of the cooperation we have had and the effective working relationships that have been created with industry and with the military services. Also, I mentioned the growing effectiveness of our work with universities and with scientists in many fields. However, this record would be incomplete without an expression of the very close working relationships that have been created with other organizations within the government, particularly the Atomic Energy Commission, the National Science Foundation, the Federal Aviation Agency, and the Weather Bureau and other areas of the Department of Commerce.

The National Academy of Sciences through its Space Science Board continues to serve as the senior advisory group to NASA on science. The Board in cooperation with NASA has set up procedures for making extended studies of the opportunities and priorities within general areas of science through panels and summer study groups. In addition, the Board studies the ongoing programs and future planning of NASA in some detail and has been helpful in all matters relating to science and the scientific community.

Our rapid rate of advance and the success we have achieved already has, we believe, denied the USSR many of the benefits and many of the options which the Soviets expected their space program to provide as a part of their forward thrust toward world domination. However, there is every evidence, on the basis of their activity during the past three years, that the Russians intend to maintain a vigorous effort in space, and, in fact, that their activities may be further increased. During 1963 and 1964 more Soviet spacecraft were put in earth orbit or deep space than in the six previous years combined. The number placed in orbit last year was double that of the year before.

The Soviet Union put 36 spacecraft into earth orbit and launched two deep space probes in 1964. These missions included the three-man Voskhod spacecraft; a second so-called "maneuverable" satellite in the Polyot series; three "heavy Sputnik" orbital platforms which launched the unsuccessful Zond I probe toward Venus, the Zond II probe now on its way toward Mars, Cosmos 41; and 31 other satellites in the Cosmos and Elektron series.

It would be a mistake, therefore, to feel that the Russians are no longer pursuing an active and vigorous program or that they do not see many advantages of a virorous space effort.

Whatever that country may do, we have built a strong space capability on which to base all actions which may be requiredin our national interest. As you go further into the details of our program, I believe, you will agree that the broad base of our activities is providing the capabilities we must have for all purposes in space.

Thank you again for this opportunity to appear before you.